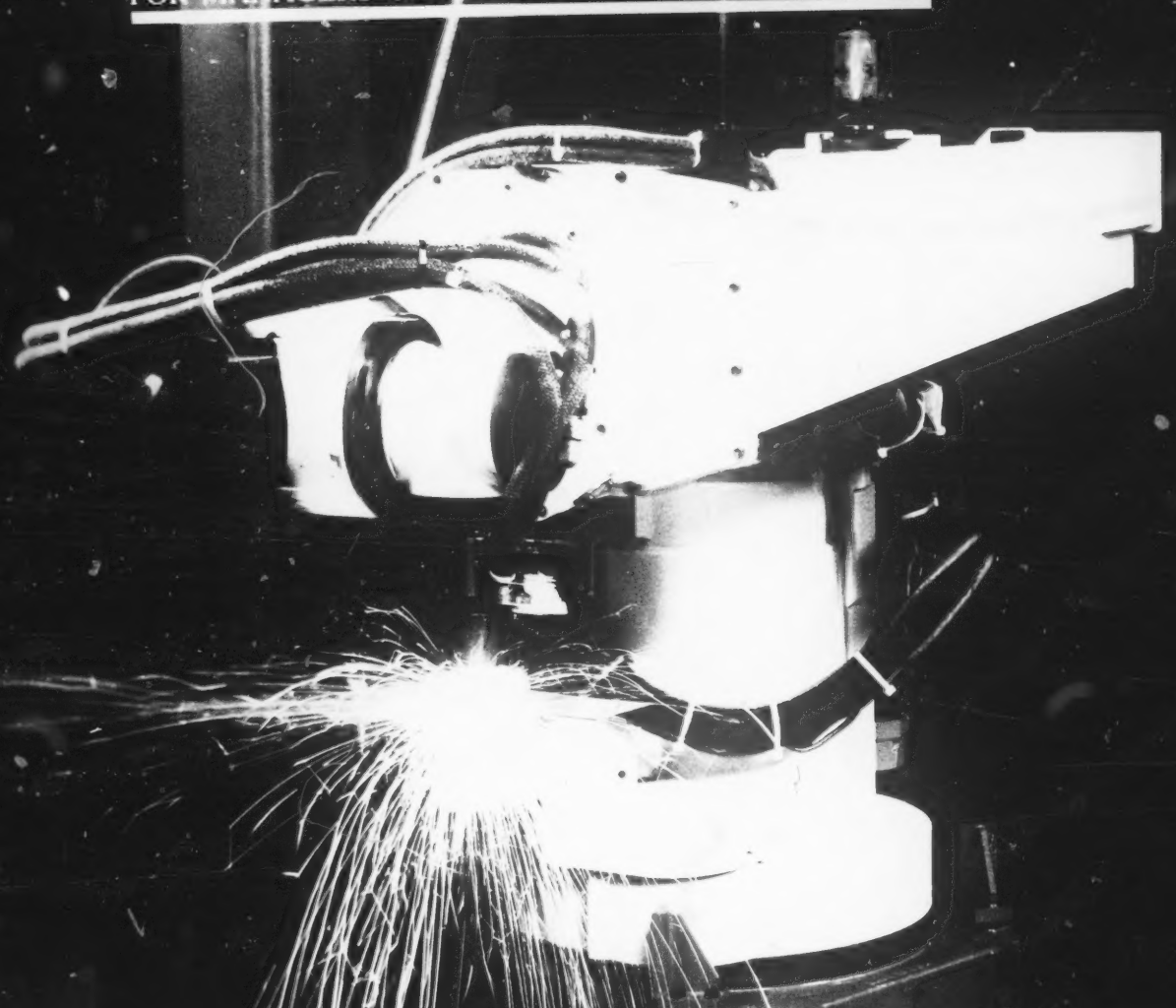
NOVEMBER 1988

PRODUCTION

FOR MANAGERS OF MANUFACTURING TECHNOLOGY



THE HEAT IS ON
Lasers Meet Robots

Building the Quant

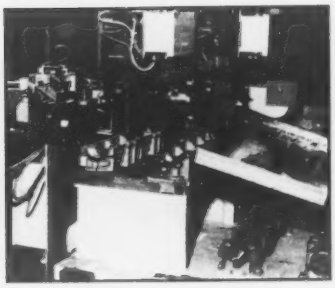
NOVEMBER 1988

PRODUCTION
COVER-TO-COVER

VOL. 100 NO. 11

Cover photo courtesy of GMFanuc Robotics Corp., Auburn Hills, MI.

34



48

62

FEATURES

34 LASERS HEAT UP ROBOTICS

44 THE LASER CLICKS AT KODAK

48 VIP = VERY IMPRESSIVE PLANT
Assembly of GM's Quad 4 engine is accomplished by a mixture of automated and manual systems, an approach that results in total process control.

54 GOLF, GUTS, AND GLORY: THE AMERICAN AUTO INDUSTRY 1988

59 DIALING FOR SOLUTIONS AT SQUARE D

62 'ANOTHER TOOL, ANOTHER RESOURCE'
At New Process Gear, quality is a fundamental element of the company's culture.

DEPARTMENTS

3 EDITORIAL AND BUSINESS STAFF

7 PERSPECTIVE
—Industrial Waste... of a Vital Kind

10 PRODUCTION UPDATE
—Die Caster Shoots for Perfect
—The Quality Factor

25 WORTH MENTIONING

29 ON THE MANAGEMENT SIDE
—The Six Deadliest Management Sins

32a READER SERVICE CARD

65 CIM/SOFTWARE

69 QUALITY PRODUCTION

73 BUYERS' GUIDE

88 LITERATURE

94 MEETINGS

94 CLASSIFIED

95 DISTRICT SALES OFFICES

95 ADVERTISERS' INDEX

96 BACK OF THE BOOK
—Stormy Weather

1

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Software To Manage the Plant Floor

A sampling of software packages for plant-floor monitoring and control applications is showcased.

By Paula M. Noaker
Associate Editor

LAST MONTH, PRODUCTION Magazine discussed functionality of the various plant-floor monitoring and control (PFM&C) software options. (See "Getting a Software Grip on the Plant Floor," October, 1988.) Here's an overview of some of the software packages available to run the operations...

• According to Optimation Inc. (Las Cruces, NM), a key to justifying flexible automation is the ability to reduce the length of time that money is invested in the manufacturing process. For example, if a $1-million investment in work-in-process inventory can be eliminated by a $500,000 automation project, then present and future savings accrue. However, the key is the ability to maintain system flexibility and control.

The company offers Optiflex software, which, when given production requirements, orchestrates the manufacturing process. Using NC code, machine set-up instructions, and man-readable instructions, the system directs robotic systems, NC machines, PLCs, personnel, etc., to retrieve raw material, produce and inspect parts, control and monitor machine processes, and generate production status reports. The software functions as an expert system, using artificial intelligence methodology to react properly to the dynamics of the shop floor; e.g., it "learns" as company-specific manufacturing data is input into its data base. Key to the Optiflex software package is its ability to increase functionality as needed, without requiring the end user to buy an additional software system. *Circle 260.*

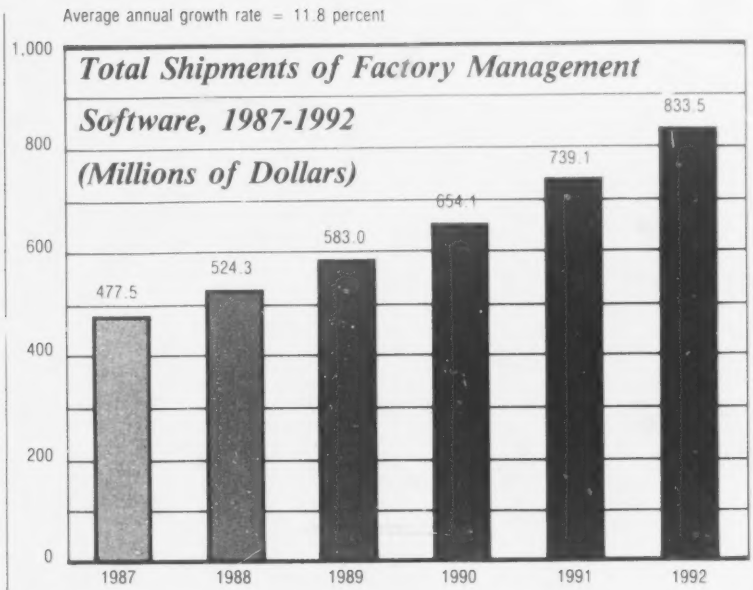
• ITP Enterprise Software Inc., a subsidiary of ITP Boston Inc. (Cambridge, MA), offers cell-control software to manage, coordinate, and monitor part production in automated cells, including machining, composite, welding, and assembly cells. The platform software mixes "off-the-shelf" availability with a degree of customization. ITP mates its standard support environment, called Mainstream, to a company's core system, which consists of operating systems, networks, and data bases already in use. The end user decides the level of system functionality by selecting standard modules such as materials management, tool management, station control and monitoring, and schedule execution. These can be augmented by material-handling control and monitoring, statistical process control, preventive-maintenance-management modules, etc. at a later date. *Circle 261.*

• FACTROL Inc. (West Lafayette, IN) offers Factor, a simulation-based software package for interactive scheduling. The system is based on finite-capacity planning; MRP and shop-floor data can be loaded into its data base, and information can be modified in the data base. In addition, scheduling alternatives can be simulated when an operator is absent, a machine is down for maintenance, materials are unavailable, etc. to determine available options. A hard copy can then be generated for the shop floor. The software runs on MS-DOS, VMS, and UNIX operating systems, and is programmed in C to facilitate application-specific configurability. *Circle 262.*

• Northern Research and Engineering Corp. (Woburn, MA) offers the Work Cell Manager, a system for factory-floor monitoring and control that runs on DEC MicroVAX hardware. The software gathers real-time operating information from manufacturing machines, robots, counters, testers, and other shop-floor equipment, managing data that is automatically acquired across shop-floor local area networks. Shop-floor personnel have immediate access to production status, including problem annunciation and trend analysis, machine failure and service history reports, production histories for individual assemblies and components, quality rate tracking, process limits and PLC program management, and automated on-line statistical control.

According to NREC, the system works well in manufacturing environments where multiple programmable controllers are used. The flexible configuration can address a range of production environments including multiple work cells on a single computer. A high-capacity design permits multiuser interactive stations with specific displays for different access levels for factory workers and production managers. *Circle 263.*

• D. L. Hiller & Associates (Sterling Heights, MI) offers version 4.0 of the Factory Data Manager that provides a factory network of data collection terminals and wands to collect and validate worker-entered data, in addition to sensors and programmable-controller data. It also can model plant rules in artificial intelligence formats and upload or download information between the network and machine tools. In an interesting twist, the system merges the concept



According to Automation Research Corp. (Medfield, MA), the U.S. market for factory management software should jump to $830 million by 1992 (at an average annual growth rate of 12 percent), up from $525 million in 1988. Of this, cell control will capture $80 million by '92, at an average annual growth rate of 38 percent. Quality management software will tally $34 million, averaging only 10 percent growth annually as more quality management functions are taken on by cell control or MRP II software. Production scheduling should reach $120 million, at a compounded annual growth rate over 27 percent. Computer-aided process-planning software shipments will increase to nearly $30 million in 1992 from less than $10 million in '87, and maintenance management software will grow an average 16 percent annually to $20 million. MRP II, a large, mature market compared to other types of software systems, is expected to lose significant market share over the next four years.

On the hardware front, ARC estimates supervisory controllers cornered 9.3 percent of 1987's $1.04 billion in plant-management computer-system shipments. By '92, controllers should increase to 12.3 percent of a $1.78 billion market. Supermicros, which grabbed 28.5 percent of last year's market, will tally 38.4 percent of total shipments.

of Kanban, which is a manual pull-material-through-on-demand tracking system, with MRP, a push-the-information computerized system. The FDM provides a visual view of each p Kanban workcenter dispatch rack, allowing the schedule to be viewed from every LAN station. The p cards on the rack still handle dispatching and pull-through production, however, it isn't necessary to create Kanban cards for every part for each workstation. Instead, the system utilizes the bar-coded, shop-order traveler generated with the MRP system. *Circle 264.*

• Hewlett-Packard Co. (Palo Alto, C[illegible], in association with Hilco Technologies Inc. (St. Louis) offers [illegible]nitrol/UX, a flexible software-design framework for the implementation of computer-integrated-manufacturing information systems. This package provides systems integrators and end users with a menu-driven application-development environment to configure their own monitoring and control solutions for cell control and area management. The software runs exclusively on HP 9000 Model 300 and Model 800 technical computers. Expect to see more working partnerships of this type, especially with application shell-type software. *Circle 265.*

• McDonnell Douglas Information Systems Co. (St. Louis) offers the MATROL family of software products. The system currently features DNC, time and attendance, labor reporting, and work-order tracking software packages, connected by the Software System Data Xpressway (SSDX). The SSDX interface facilitates addition of application shells and permits data transfer to and from the company's Unigraphics CAD/CAM system, in addition to MRP II systems. The baseline application set of functionalities and requirements is designed around the messaging system, Objective C; the ORACLE relational-data base management system; and SQL*Forms. *Circle 266.*

Relational data base and SQL are key terms in this software package and many others. In brief, a relational data base, as opposed to a hierarchical structure, represents data in tabular form. This allows significant flexibility in how an end user retrieves data, views it, and manipulates it. Although some claim relational data bases suffer performance-wise when compared with hierarchical data bases (used to store data in many MRP II systems), specific vendors, such as Oracle Corp. (Belmont, CA), are said to offer products that aren't in the least bit sluggish *(circle 267).* However, you probably won't see an us-versus-them situation—relational versus hierarchical. More likely, both types of data bases will be represented in the same plant. The issue

will be whether or not they can transfer data back and forth.

SQL, or standard query language, is similar to a standard in that it provides a set of guidelines on how data will be stored, represented, and manipulated.

• Manufacturing Decision Support Systems Inc. (Cleveland) calls its manufacturing planning and control system MDSS/Metals. Functions include estimating and quoting, custom order management, material management, labor management, financial control, a security and training system, and a 4 GL (fourth-generation language) report writer. Although 4 GLs aren't prevalent now, the concept should become more important for manufacturing management as the software increases in sophistication. The basic premise is that a 4 GL report writer allows manufacturing management to access information in a data base and design appropriate reports using simple English queries. A working knowledge of a third generation compiled language (C, FORTRAN, etc.) isn't necessary. *Circle 268.*

• Data Systems for Industry (Cypress, CA) and Stratus Computers (Marlboro, MA) offer a jointly-developed software package called DSI Shop, which they peg as an entry-level CIM system. The software performs order launching and dispatching, operation scheduling, workcenter loading, order tracking, and launched capacity planning. The package is built on a modular, expandable platform and runs at high availability on Stratus' Model 50 minicomputer, which means terminals can still perform transactions while batch jobs run in the background. *Circle 269.*

• System Software Associates Inc. (Chicago) offers the Business Planning and Control System (BPCS) as a fully integrated manufacturing, distribution, and financial package for IBM System 3/X and AS/400 computers. According to SSA, it is suitable for repetitive or job-shop production in both make-to-order and make-to-stock environments.

Software modules include shop-floor control, cost accounting, manufacturing data management, demand forecasting, material requirements planning and master production scheduling, capacity planning, and performance measurement. *Circle 270.* P

Send information for CIM/Software to Paula M. Noaker, Associate Editor, PRODUCTION, 1100 N. Woodward Ave., Suite 120, Birmingham, MI 48009.

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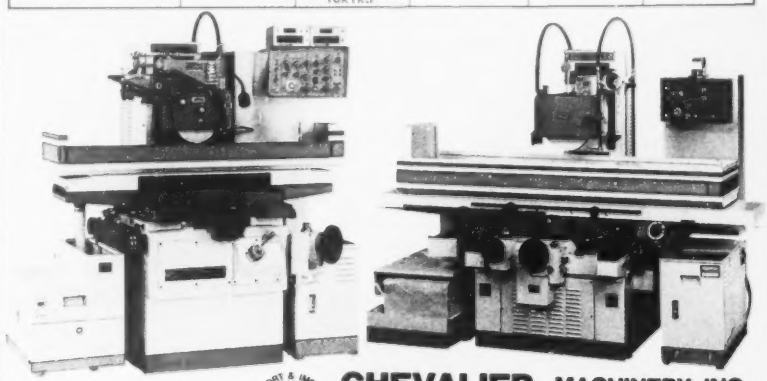

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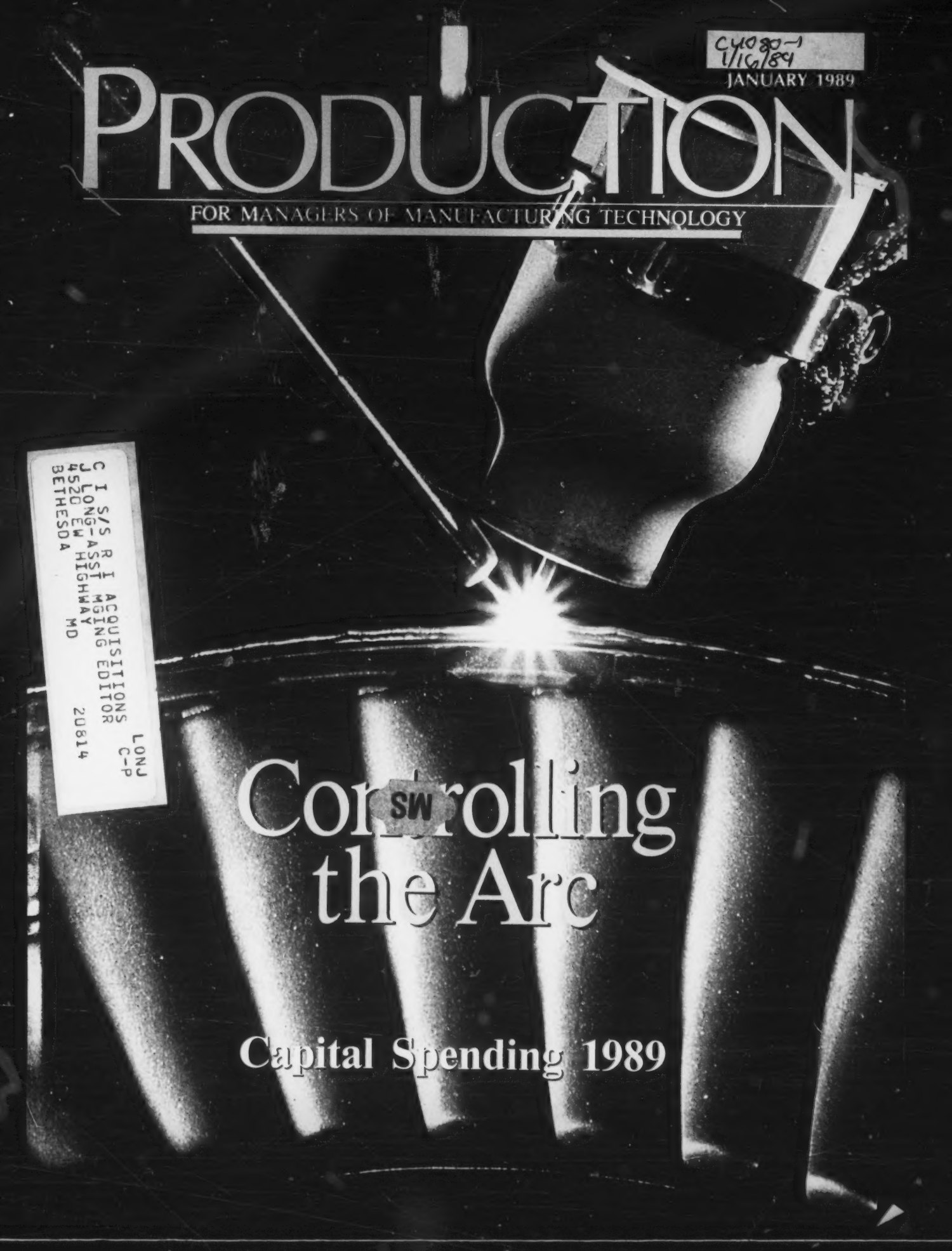

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Controlling the Arc

Capital Spending 1989

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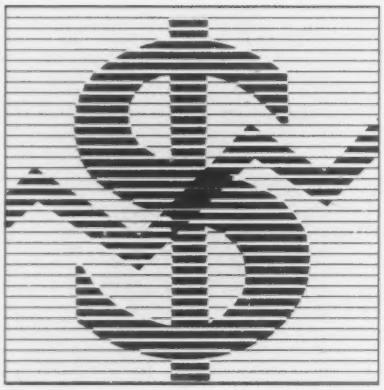

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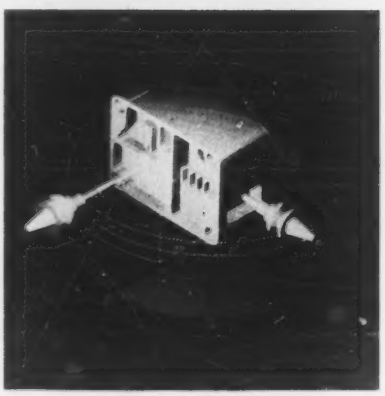
34



40

About the cover: The Dabber arc-welding system from the Hobart Brothers Co. (Troy, OH) is shown rebuilding a knife-edge seal on the fourth-stage rotor turbine assembly of a jet engine. The computer-controlled TIG process throws minimal heat into the metal, allowing deposition of several thin layers of weld material to rebuild the part edge without part distortion.

FEATURES

BUSINESS STRATEGIES

26 Capital Spending 1989: America Bounces Back

The Rust Belt is getting a brand-new, highly polished finish in the form of increased amounts of machinery and equipment. It may have been down, but certainly not out. And it looks like it's back—with a vengeance.

ASSEMBLY

34 Controlling the Arc

Automatic arc welding has come many a mile from when automotive was the major customer. As peripheral technologies get sophistication, more applications open up in other industries.

MANUFACTURING TECHNOLOGIES

40 WYSIWYG

That means "What You See Is What You Get"...an appropriate phrase as applied to Autofact 1988, which was big on CAD and merely nodding at CAM.

CIM/SOFTWARE

46 Making Cables With CIM

QUALITY

51 Crosby Says Get Fit for Quality

DESIGN

55 What Manufacturing Managers Should Know About CAD

MATERIAL HANDLING

59 Manual System Streamlines Batch Handling

MATERIALS

61 There's More Than One Way To Skin a Car

DEPARTMENTS

5 Staff
7 Perspective
10 Production Update
20 Worth Mentioning
23 On The Management Side
65 Books and Films
66 Buyers' Guide
74 Literature
78 Calendar
79 Advertisers' Index
79 District Sales Offices
80 Back of the Book

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Capital Spending 1989: America Bounces Back

The Rust Belt is getting a brand-new, highly polished finish in the form of increased amounts of machinery and equipment. It may have been down, but certainly not out. And it looks like it's back—with a vengeance.

By Edward D. McCallum, Jr., *Vice President, Indumar Inc.**
and Gary S. Vasilash, *Executive Editor*

THE BOTTOM LINE IS BIGGER THIS year. According to the PRODUCTION 1989 Capital Spending Survey,** spending on machinery and equipment (not bricks, mortar and real estate) will be up 11.1 percent over 1988, to an adjusted total of $9.91 billion, up from $8.79 billion. There is optimism in American manufacturing. But it's optimism based on something solid: 49.7 percent of the companies report that incoming orders are increasing. Only 5.5 percent note a decrease.

What's more, in the July-August 1988 period during which this survey was conducted, plants reported that they were operating at 79.6 percent of capacity, up from 77 percent in the same period a year previous.

The point is, this isn't a phenomenon that is restricted in scope to 1989. In fact, the companies as a group spent more money in 1988 than they had planned to: 105 percent of their original estimations. One very big spender (it expects to invest $850 million this year) spent 115 percent of its intended 1988 budget. This is despite the October 1987 stockmarket crash that some observers said would put the brakes on capital investments.

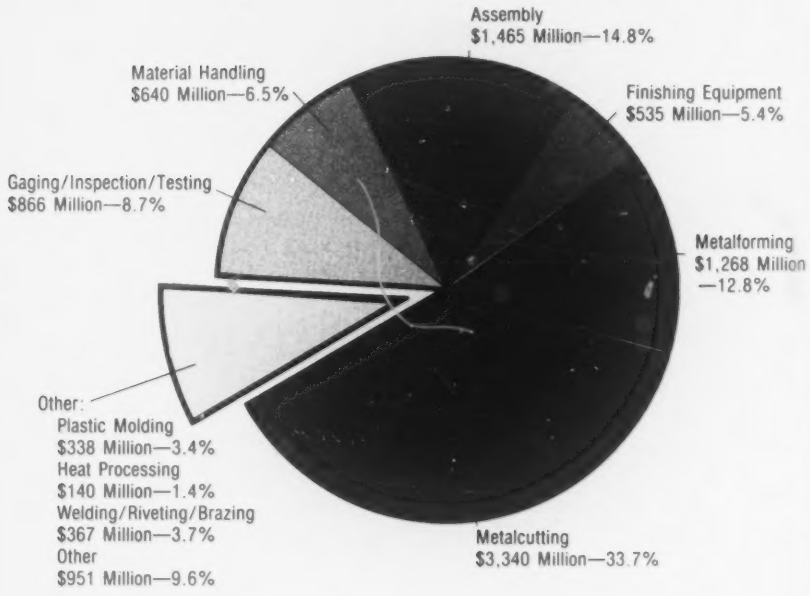
Boost to domestic builders. The dollar-yen relationship gives a boost to builders of American equipment, that and the fact that the Japanese seem to be refortifying their production infrastructure, which means that they are absorbing machinery and equipment, products which might otherwise be destined for U.S. shores.

Some companies are beginning to realize that in order to use manufacturing as a competitive weapon they need to increase their amount of spending on new machinery and equipment. Given the predominant power of the financial people in

**Note: This is the 21st time that Ed McCallum has conducted the PRODUCTION Capital Spending Survey. He has done it both as an employee of PRODUCTION Magazine and as a consultant. Indumar is a Cincinnati-based industrial market research firm. McCallum specializes in manufacturing technologies.*

***The information for this survey is a result of sending questionnaires to PRODUCTION readers in 10,000 different plants. Of the total, 6,000 went to plants employing over 250 people. The remaining 4,000 were selected on an Nth plant basis of facilities with fewer than 250 people. All of the plants were in one of the following Standard Industry Classification (SIC) groupings: SIC 34, Fabricated Metal Products; SIC 35, Machinery, except electrical; SIC 36, Electrical Machinery; SIC 37, Transportation Equipment; SIC 38, Instruments. Additionally, some plants in the Metal Furniture category of SIC 25 received the survey. Of the total 10,000, 3,094 questionnaires were determined useable.*

1989 Capital Equipment Spending Projections by Type of Equipment



spending, this realization can be interpreted from the required minimum pre-tax, first-year, return-on-investment (ROI). Although the average is 30.5 percent for the total number of respondents, approximately half of the respondents say that the ROI is just 15.8 percent. Which means that many companies are being encouraged to spend money. (One big non-automotive manufacturer that is being pressed by off-shore competition has relaxed its first year ROI to less than 10 percent, recognizing the necessity of having productive equipment in place without having undue worry about achieving a rapid return. After all, the alternative could be no returns, period.)

The big spend big—and early. The money is where the money always has been. In the coffers of the big plants. That is, in plants with fewer than 20 employees, the expected median 1989 investment in plant and equipment is $75,000. That figure is more than tripled—goes to $250,000—for plants with from 100 to 249 employees. There's a jump to $550,000 for plants with 250 to 499 people, and in plants with from 500 to 2,499, the planned per plant expenditure is $1,750,000. At the top, the plants with 2,500 or more employees, the median spending figure is $2,500,000. (More than half of the 3,094 valid responses came from plants with employment ranging from 100 to 499 people [41 percent] and from 500 to 999 [14.7 percent].)

And the monies they've designated for capital equipment spending in 1989 is well on its way to the builders of machinery and equipment. Some of it has been there for six months already. That is, approximately one-third of the respondents had placed 50 percent or more of their 1989 orders in the summer of 1988. (The average plant placed 12 percent of budget; the median was 25 percent.)*

Which leads us to suspect that it's possible that the deeper well for 1989 may run dry fairly quickly. And that borrowing into 1990's funds could occur, which could setup a skewed spending pattern.

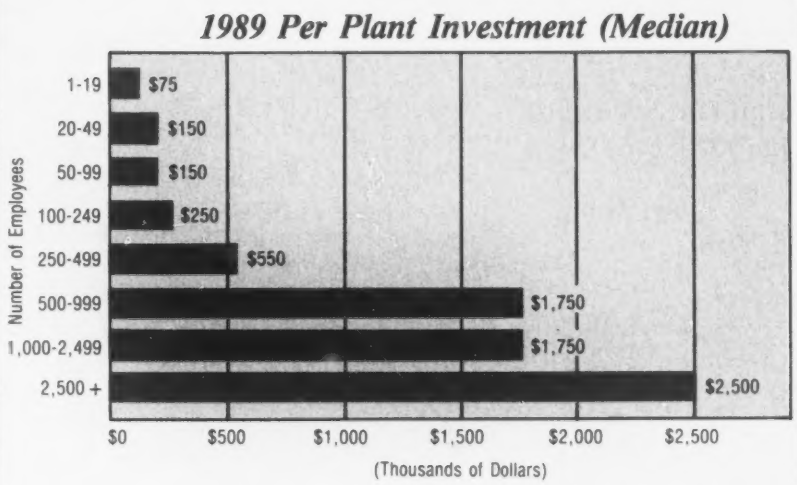
Capacity crunch? However, there is something that could mollify that trend. The U.S. machine tool building capacity has, over the past several years, been shrinking. Companies have gone out of business. Companies are going out of business. Companies are becoming consolidated with other companies, which often means that *x* capacity and *y* capacity are becoming *x* minus *y* capacity.

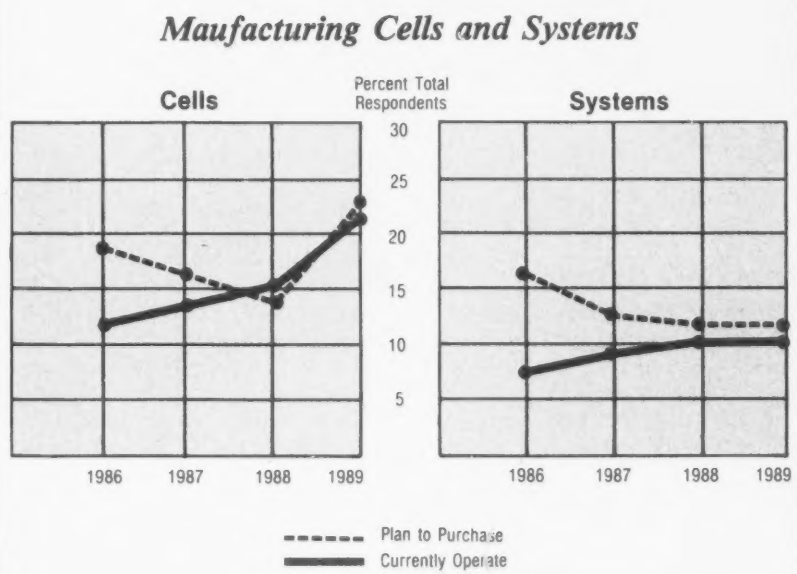
It could be that some companies spent a portion of their monies ahead of the calendar year so that they were able to get good places in line, as orders are getting strung out in these rapidly filling capacities.

If business continues at a good level, then the issue of deliveries may become of key importance.

The survey shows that domestic production equipment builders will receive 72 percent of the business and 18 percent will be foreign sourced. It should be noted that this is the first time that foreign equipment sourcing has dropped below 20 percent since 1985 (17 percent), after peaking in 1988 at 29 percent. However, domestic metalcutting and metalforming equipment manufacturers cannot afford to be too sanguine. Off-shore equipment will still be coming in at a hefty rate, although somewhat weakened. For example, metalcutting sourcing has been about 50-50, domestic and off-shore, during the past few years. Last year the domestic total was up to about 70 percent. Although there are Voluntary Restraint Agreements (VRAs) in place that are to protect American builders, due to

**Note: Not everyone had their money at the time of the survey. But those awaiting approval expected to receive 91 percent of that they wanted, which is the highest figure reported to date.*





machine tool demand in Japan, they really haven't been tested.

There are three primary factors behind off-shore sourcing: equipment quality, features, and price. Since 1985 the issue of service has been creeping up, from 10.5 to 19.4 percent. It's expected that the issue of service will grow as the population of foreign equipment rises in the U.S.

Addressing assembly labor. Once again, direct labor stands as the number-one reason for investment in capital equipment, with 65.9 percent of the respondents indicating that that's one of their motivators. Although this may seem somewhat peculiar, given that the direct labor in manufacturing is approximately 10 percent of overall cost, there is a growing area, which is assembly. The survey shows that although metalcutting remains the number-one area of investment, $3,340,000,000, or 33.7 percent of the total, assembly has jumped 41 percent over last year, and is now in the number-two spot. That is, in 1988 $1,030,000,000 was slated for assembly investment; the number is $1,465,000,000 in 1989.

What's more, in the areas of flexible cells and flexible systems, assembly is very strong. In fact, in systems, assembly ranks as the primary function in 45.6 percent of the cases. Metalcutting is number two, at 40.7 percent. Although metalcutting is number one in flexible cells, its margin over assembly is slim: 46.8 percent to 42.8 percent.

The point is, assembly is a very labor-intensive operation. These spending patterns indicate that efforts are being made to change that.

Other investment reasons, such as material costs, in-process inventory, and indirect labor remain substantially stable. But one big jump, from 32.9 percent in 1988 to 42.1 percent in 1989 is scrap and rework. Waste is clearly on the way out. This observation is further substantiated by an increase in spending in the gaging-inspection-testing category. Last year, $694 million, or 7.9 percent of the total capital spending pie, was that category's slice. This year, the slice is bigger, measuring 8.7 percent of the total, or $866 million.

Cells strengthen; systems fade. Returning to cells, it's worth noting that they are being embraced by more companies than ever before. In the 1988 survey, 14.9 percent reported that they operated cells (defined as "one materials handling device servicing multiple machines which are coordinated and paced by a computer or programmable controller"). In 1989's, 21.8 percent indicate that they currently operate cells.

And there are more to come. Between 1989 and 1991, 23 percent plan to purchase cells. This can be compared with 14.4 percent who said that they planned to buy between 1988 and 1990.

Systems don't fare nearly as well. In fact, the number of companies

reporting system operations dropped 0.3 percent in 1989 from 1988. Those planning to purchase a system during the next three years are 11.6 percent, which is up just 0.4 percent from a year ago.

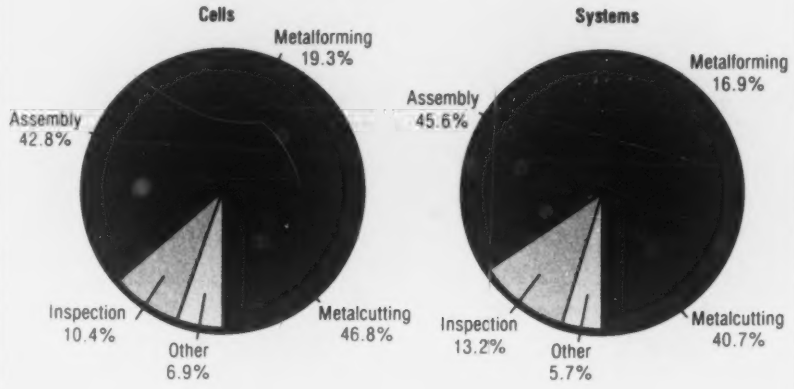
The numerical control/computer numerical control (NC/CNC) arena is probably nearing its maximum. 66.9 percent of the respondents say that they use NC/CNC equipment. About 70 percent will probably be a maximum. The average number of controlled machines is six per plant. 53.9 percent of the respondents plan to buy more within the next three years.

Computer use is rising, up to 82.7 percent versus 73.4 percent in 1988. And 66.8 percent plan to add additional manufacturing software in the next three years. The top five software applications are: computer-aided design (CAD), production control, NC/CNC programming, inspection/quality control, and MRP/MRP II.

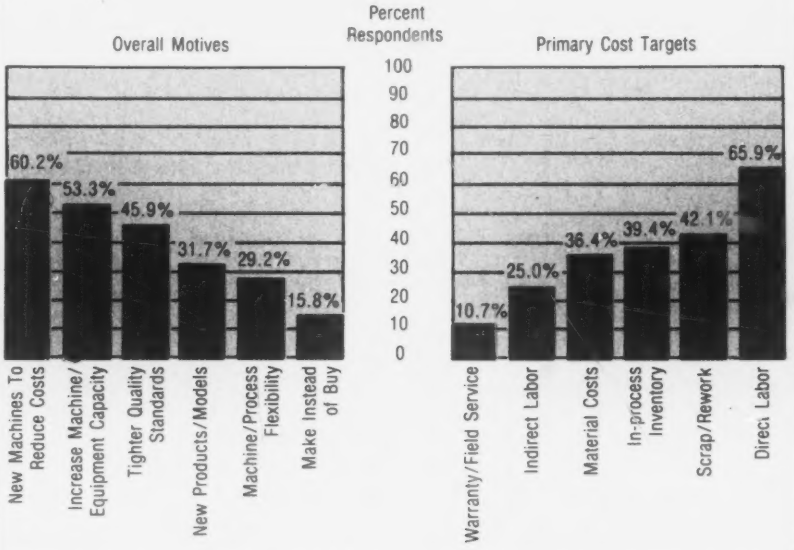
High-tech is limp. With regard to what some consider the more "advanced" or "nontraditional" technologies, things remain slow. Just 22.8 percent say that they use electrical discharge machining (EDM) equipment; only 9.2 percent plan to buy any during the next three years.

Lasers do somewhat better, with 13.1 percent of the respondents planning to purchase lasers. With regard to applications, 46 percent indicate gaging-measurement; 36.6 percent note cutting; welding, drilling and heat treating are 20.9, 14.1 and 5.2 percent, respectively. There is an apparent anomaly in that although gaging-measurement ranks as number one, helium-neon lasers, the type used for that process, ranks three out of three in application (i.e., 15.9 percent, compared with 24.6 percent for CO_2 and 17.2 for Nd:YAG). However, this may be that a company would use fewer helium-neon lasers for, say, alignment than it would need for production cutting or welding, operations which can be performed with CO_2 and Nd:YAG lasers.

Primary Functions for Cells and Systems To Be Purchased 1989-91



1989 Capital Investments



Robotics continues on its anemic path. In 1985, 36.9 percent reported that they were using robots. The 1989 survey has 24.3 percent using them. And five years ago, 33 percent of the plants indicated that they planned to buy robotic devices. This has fallen to 21.7 percent in the 1989-1991 time frame. The perennial number-one use is machine load/unload. Just two percentage points separate it from number-two, assembly, which relates back to the earlier emphasis on putting things together.

In fact, "putting things together" just may be the appropriate image for what is happening in American industry today.

The following pages show 1989 spending patterns (by SIC) based on the results of PRODUCTION's Capital Spending Survey.

Spending Patterns

For each of the nine production equipment categories listed, the industries cited are those that account for at least 75% of the planned 1989 investments for that particular type of equipment. Industries not listed do not make significant investments in equipment of that type. Comparing your company's investment plans with your industry is simple. Determine the amounts, by percentage, of total capital expenditures budgeted for each of the equipment categories. Then compare those amounts with the listings.

Cleaning and Finishing Equipment

The average respondent company will allocate 5.4% of total investment to cleaning and finishing equipment.

SIC	Industry	% of Total Capital Expenditures
251	Household furniture	10.7
252	Office furniture	15.2
253	Public building and related furniture	7.5
254	Partitions, shelving, lockers, and office store fixtures	16.6
259	Miscellaneous furniture and fixtures	7.2
341	Metal cans and shipping containers	7.6
342	Cutlery, handtools, hardware	7.7
343	Heating equipment, except electric and warm air; and plumbing fixtures	11.7
344	Fabricated structural metal products	9.3
347	Coating, engraving, and allied services	49.2
352	Farm and garden machinery and equipment	13.5
358	Refrigeration and service industry machinery	5.9
361	Electrical transmission and distribution equipment	6.7
363	Household appliances	8.0
364	Electric lighting and wiring equipment	7.4
365	Radio and TV receiving equipment, except communication types	6.0
371	Motor vehicles, motor vehicle equipment	7.2
375	Motorcycles, bicycles and parts	18.3

Assembly Machines/Equipment

The average respondent company will allocate 14.8% of total investment to assembly machines/equipment.

SIC	Industry	% of Total Capital Expenditures
342	Cutlery, handtools, hardware	17.6
348	Ordnance and accessories, except vehicles and guided missiles	16.0
357	Office computing and accounting machines	33.0
358	Refrigeration and service industry machinery	17.5
361	Electrical transmission and distribution equipment	18.6
362	Electrical industrial apparatus	20.3
363	Household appliances	18.2
364	Electrical lighting and wiring devices	26.1
365	Radio and TV receiving equipment, except communication types	30.1
366	Communications equipment	29.1
367	Electronic components and accessories	28.9
369	Miscellaneous electrical machinery, equipment and supplies	37.5
371	Motor vehicles, motor vehicle equipment	19.5
374	Railroad equipment	18.8
375	Motorcycles, bicycles and parts	21.7
382	Measuring and controlling instruments	23.0
383	Optical instruments and lenses	16.3
384	Surgical, medical and dental instruments and supplies	24.9
386	Photographic equipment and supplies	21.5
387	Watches, clocks, clockwork-operated devices, and parts	44.3

Welding/Riveting/Brazing Equipment

The average respondent company will allocate 3.7% of total investment to welding/riveting/brazing equipment.

SIC	Industry	% of Total Capital Expenditures
252	Office furniture	9.2
253	Public building and related furniture	12.5
254	Partitions, shelving, lockers and office and store fixtures	7.9
259	Miscellaneous furniture and fixtures	13.3
341	Metal cans and shipping containers	3.4
343	Heating equipment, except electric and warm air; and plumbing fixtures	7.4
344	Fabricated structural steel products	10.6
349	Miscellaneous fabricated metal products	4.8
351	Engines and turbines	5.7
352	Farm and garden machinery and equipment	3.9
353	Construction, mining and material handling machinery and equipment	6.1
355	Special industry machinery	4.7
358	Refrigeration and service industry machinery	5.3

361	Electrical transmission and distribution equipment	6.5
363	Household appliances	3.2
371	Motor vehicle, motor vehicle equipment	5.4
373	Ship and boat building and repairing	3.8
374	Railroad equipment	18.9
375	Motorcycles, bicycles and parts	10.0
379	Miscellaneous transportation equipment	10.0

Material Handling Equipment

The average respondent company will allocate 6.5% of total investment to material handling equipment.

SIC	Industry	% of Total Capital Expenditures
251	Household furniture	13.7
252	Office furniture	13.8
253	Public building and related furniture	21.3
341	Metal cans and shipping containers	11.6
342	Cutlery, handtools, hardware	7.1
343	Heating equipment, except electric and warm air; and plumbing fixtures	7.4
344	Fabricated structural metal products	7.7
347	Coating, engraving and allied services	7.1
349	Miscellaneous fabricated metal products	6.4
352	Farm and garden machinery and equipment	6.8
353	Construction, mining, oil field and material handling equipment	8.4
357	Office, computing and accounting machines	11.2
358	Refrigeration and service industry machinery	8.6
361	Electrical transmission and distribution equipment	7.7
363	Household appliances	8.6
364	Electrical lighting and wiring equipment	9.9
365	Radio and TV receiving equipment, except communications types	11.9
366	Communications equipment	8.5
367	Electronic components and accessories	7.1
369	Miscellaneous electrical machinery, equipment and supplies	7.8
371	Motor vehicles, motor vehicle equipment	9.5
374	Railroad equipment	8.1
376	Guided missiles and space vehicles and parts	12.1
379	Miscellaneous transportation equipment	7.1
381	Engineering, laboratory, scientific and research instruments and equipment	7.3
386	Photographic equipment and supplies	6.7

Metalforming Machinery/ Equipment

The average respondent company will allocate 12.8% of total investment to assembly machines/equipment.

SIC	Industry	% of Total Capital Expenditures
251	Household furniture	28.1
252	Office furniture	41.6
253	Public building and related furniture	28.8
254	Partitions, shelving, lockers, and office and store fixtures	27.1
259	Miscellaneous furniture and fixtures	22.2
341	Metal cans and shipping containers	26.9
342	Cutlery, handtools, hardware	16.7
343	Heating equipment, except electric and warm air; and plumbing fixtures	25.2
344	Fabricated structural steel products	24.9
345	Screw machine products	17.9
346	Metal forgings and stampings	42.6
352	Farm and garden machinery and equipment	24.5
353	Construction, mining and material handling machinery and equipment	15.1
358	Refrigeration and service industry machinery	34.5
361	Electrical transmission and distribution equipment	15.8
363	Household appliances	30.5
364	Electrical lighting and wiring equipment	14.9
371	Motor vehicles, motor vehicle equipment	11.9
373	Ship and boat building and repairing	17.7
374	Railroad equipment	13.8
386	Photographic equipment and supplies	14.8

Gaging/Inspection/Testing Equipment

The average respondent company will allocate 8.7% of total investment to gaging/inspection/testing equipment.

SIC	Industry	% of Total Capital Expenditures
341	Metal cans and shipping containers	10.6
346	Forgings and stampings	7.6
348	Ordnance and accessories, except vehicles and guided missiles	11.1
351	Engines and turbines	13.4
354	Metalworking machinery and equipment	9.1
357	Office, computing and accounting machines	13.7
361	Electrical transmission and distribution equipment	9.8
362	Electrical industrial apparatus	10.3
364	Electrical lighting and wiring equipment	9.1
366	Communications equipment	17.5
367	Electronic components and accessories	11.1
369	Miscellaneous electrical machinery, equipment and supplies	9.2
371	Motor vehicles, motor vehicle equipment	8.2
372	Aircraft and parts	12.4
381	Engineering, laboratory, scientific and research instruments and equipment	12.1
382	Measuring and controlling instruments	15.6
383	Optical instruments and lenses	13.9

SIC	Industry	% of Total Capital Expenditures
384	Surgical, medical and dental instruments and supplies	12.0
387	Watches, clocks, clockwork-operated devices, and parts	7.7

Plastic Molding Equipment

The average respondent company will allocate 3.4% of total investment to plastic molding equipment.

SIC	Industry	% of Total Capital Expenditures
253	Public library and related furniture	7.5
259	Miscellaneous furniture and fixtures	8.9
341	Metal cans and shipping containers	11.4
343	Heating equipment, except electric and warm air; and plumbing fixtures	5.5
347	Coating, engraving and allied services	3.7
349	Miscellaneous fabricated metal products	3.1
361	Electrical transmission and distribution equipment	9.4
362	Electrical industrial apparatus	4.9
363	Household appliances	13.0
364	Electrical lighting and wiring equipment	9.7
365	Radio and TV receiving equipment, except communications types	18.2
367	Electronic components and accessories	4.7
369	Miscellaneous electrical machinery, equipment and supplies	6.7
371	Motor vehicles, motor vehicle equipment	4.4
373	Ship and boat building and repairing	8.3
381	Engineering, laboratory, scientific and research instruments and equipment	4.0
382	Measuring and controlling instruments	6.2
384	Surgical, medical and dental instruments and supplies	8.8
385	Ophthalmic goods	10.0
386	Photographic equipment and supplies	10.9

Metalcutting Machine Tools

The average respondent company will allocate 33.7% of total investment to metalcutting machine tools.

SIC	Industry	% of Total Capital Expenditures
345	Screw machine products	53.3
348	Ordnance and accessories, except vehicles and guided missiles	38.5
349	Miscellaneous fabricated metal products	38.8
351	Engines and turbines	55.2
353	Construction, mining and material handling machinery and equipment	42.0
354	Metalworking machinery and equipment	66.0
355	Special industry machinery	56.0
356	General industrial machinery and equipment	48.7
359	Miscellaneous machinery and equipment	65.1
371	Motor vehicles, motor vehicle equipment	27.4
372	Aircraft and parts	50.9
376	Guided missiles, spare vehicles and parts	38.1
379	Miscellaneous transportation equipment	42.1
383	Optical instruments and lenses	33.3

Heat Processing Equipment

The average respondent company will allocate 1.4% of total investment to heat processing equipment.

SIC	Industry	% of Total Capital Expenditures
342	Cutlery, handtools, hardware	4.7
346	Metal forgings and stampings	1.9
347	Coating, engraving and allied services	2.4
348	Ordnance and accessories, except vehicles and guided missiles	1.5
362	Electrical industrial apparatus	1.6
364	Electrical lighting and wiring equipment	2.5
365	Radio and TV receiving equipment, except communication types	2.3
367	Electrical components and accessories	3.3
371	Motor vehicles, motor vehicle equipment	1.6
372	Aircraft and parts	3.2
374	Railroad equipment	2.9
376	Guided missiles, space vehicles and parts	3.8

Thank You: Then and Now

For those of you who filled out the forms that became the PRODUCTION 1988 Capital Spending Survey, we'd like to thank you—sort of. As you may recall, the stock market crash got in the way between the submission of the survey and the publication of the January 1988 issue of PRODUCTION. Consequently, we had the pre-crash numbers. Many economists said post-crash that capital spending would come to a grinding halt. But our conclusion was that investment in capital equipment was a careful, long-considered action, which wouldn't be too adversely affected by the temporary black hole on Wall Street.

So we went with what you said.

Actually, we were off: Only because you spent more than you told us you would.

As for those of you who contributed to these 1989 findings, we'd also like to extend our thanks. We recognize that it takes time and consideration to fill out the questionnaire. And that all of you, the men and women who make industry happen, are the best window into the future of durable goods manufacturing. We greatly appreciate your help. P

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Facing Up to the Issues of Quality . . . 52

Stamping Cashes in on Change

Down-to-Earth Management at Bendix

28

34

38

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FEATURES

MANUFACTURING TECHNOLOGIES
28 Revamp Your Stamping Strategy—Not Just the Line

MATERIALS
34 How Would You Make These Cars?

BUSINESS STRATEGIES
38 'Common-sense Management' at Bendix

44 Creating Opportunities

ASSEMBLY
48 The Key to Assembly Automation: Design

QUALITY
52 A PRODUCTION Round Table: The 800 Points

64 Quality's Cascading Impact

66 The Computerized Measurement Device

DESIGN
76 Think Software

MATERIAL HANDLING
78 Unplugging the Packaging Problem

CIM/SOFTWARE
82 Develop Your Own Expert Help

DEPARTMENTS

4 Staff
9 Perspective
10 Production Update
20 Worth Mentioning
24 On The Management Side
88 Buyers' Guide
106 Literature
110 Calendar/Classified
111 Advertisers' Index
111 District Sales Offices
112 Back of the Book

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Think Software

Looking for a CAE/CAD/CAM system? One market researcher thinks that you should look beyond the hardware to the software. That's where the action is—and where the real work is done.

By Gary S. Vasilash
Executive Editor

"OVER THE LAST DECADE THE GROWTH of the mechanical computer-aided engineering/computer-aided design, and computer-aided manufacturing (CAE/CAD/CAM) market has been explosive. In 1988 more than $4.5 billion of hardware and software was purchased. Today, there are over 100 vendors marketing mechanical CAE/CAD/CAM systems. With so many vendors and product alternatives, the typical buyer has a difficult time identifying the leading vendors and sorting out their products."

That observation by Donald M. Vuchetich, vice president, CIMdata Inc. (Ann Arbor, MI) may be something of an understatement. Particularly the part about sorting things out. But the market analyst has some recommendations that can help. Overall, he advises, "The manager who is buying a system should look at and understand who the companies are that are investing in and developing the underlying technology." In his view, those companies tend to be software producers.

Vuchetich acknowledges that a highly visible trend in the CAE/CAD/CAM world is to switch from the big host computer-based systems to the 32-bit workstations and personal computers. One advantage of this, he says, is that software can work faster than before, and complex functions can be incorporated into the packages without performance deterioration. Today there is an array of modeling packages—3D, solid, finite element, parametric—that can be run on 32-bit machines with good performance.

Cheap seats and high speeds. There's another advantage to the PC/workstation boom. They are less expensive than host systems. "The cost of a CAE/CAD/CAM system has reached the level of most budgets, permitting department- and company-wide access to productive systems," Vuchetich observes. He says that workstation seats are available in the $10,000 to $20,000 range. Looking ahead, he comments, "Hardware will become more of a utility in the mechanical CAD/CAM world."

In Vuchetich's opinion, the people who are developing the software are driving CAE/CAD/CAM at higher speeds than the people who are building the hardware packages to run this code on. "In fact," Vuchetich claims, "technology development is moving faster than its application. It's happening so fast that users are not able to take advantage of all the new products on the market. We expect this development to continue for many years."

There are three areas that he thinks prospective systems users should pay attention to. They are:

- Solids modeling. He says it first appeared in the '70s from Shape Data Ltd. (Cambridge, England and now a subsidiary of McDonnell Douglas

Powerful software was once the domain of host computers. Now it can operate on workstations. Shown here is Automation Technology Products' CIMPLEX software running on the Personal IRIS workstation from Silicon Graphics (Mountain View, CA).

"Technology development is moving faster than its application—so fast that users are unable to take advantage of all the new products on the market," says CIMdata's Vuchetich.

Estimated 1988 Software Revenue of the Top Five CAE/CAD/CAM Mechanical Software Vendors

($ millions)
(% of world market)

Prime/ Computervision	McDonnell Douglas	Schlumberger CAD/CAM	SDRC	Dassault
$180	$53	$50	$48	$40
(18.5%)	(5.5%)	(5.2%)	(4.9%)	(4.1%)

Source: CIMdata

Worldwide Mechanical CAE/CAD/CAM Software Market

($ millions)

1988	1989	1990	1991	1992
$970	$1095	$1235	$1390	$1570

Source: CIMdata

Manufacturing & Engineering Systems Co., St. Louis) and Matra Datavision (Tewksbury, MA); the initial offering as a part of a CAD/CAM package was made in 1982 by Schlumberger CAD/CAM (Ann Arbor, MI; in 1982 it was Applicon). Vuchetich explains, "Solids modeling offers major improvements in product quality, and reductions in time to market by automating design and analysis, and providing checks to avoid such things as part interference."

• Surface modeling and Non-uniform Rational B-Splines (NURBS). These capabilities are generally available from vendors. The benefit: "Leading users are transferring their designs to tooling vendors as digital surface models, which eliminates errors and delays due to regenerating design data for the manufacturing applications," says Vuchetich.

• Form-feature modeling. Companies offering this capability include Schlumberger CAD/CAM, Automation Technology Products (ATP; Campbell, CA), and Parametric Technology (Waltham, MA). Observes Vuchetich, "CAE/CAD/CAM systems with form-feature capabilities are expected to improve product designs and make better use of a company's manufacturing capabilities, by designing features a company's machine tools can produce."

Ones to watch. According to Vuchetich, the major suppliers of mechanical CAE/CAD/CAM software systems are McDonnell Douglas, Prime/Computervision (Bedford, MA), and Schlumberger CAD/CAM. In some instances they offer complete packages, hardware and software; in others, some of their products are available from hardware suppliers, notably Digital Equipment Corp. (Marlboro, MA) and IBM (White Plains, NY).

Vuchetich picks some companies he thinks prospective users might want to check out. These are:

• ATP for its CIMPLEX solids, form-feature modeling system for engineering and manufacturing.

• Autodesk Inc. (Sausalito, CA) for Auto Solids, a low-cost solids-modeling system that includes finite element and NC capabilities.

• Control Data Corp. (Minneapolis) for EMS/EDL, Sherpa Corp. (San Jose, CA) for DMS, and Intergraph Corp. (Huntsville, AL) for I/PDM, all of which are systems for product data management. These systems help connect engineering, material resource planning (MRP), and manufacturing systems.

• Parametric Technology for Pro/ENGINEER, its feature-based, parametric solids-modeling system for part and assembly designs.

• Schlumberger CAD/CAM for BRAVO3, a solids-modeling-based system packed with closely integrated capabilities for various tasks.

• Structural Dynamics Research Corp. (Milford, OH) for I-DEAS (and CAEDS on IBM hardware), an engineering design and analysis system combining capabilities including solids modeling, finite element, and kinematics.

Beyond the suggestions given here, Vuchetich offers some general tips. He recommends that when looking at systems, "Focus on the software. The tool that the designer and the engineer uses is the application software, not the hardware." Also with regard to software, he says customers should know who is providing it—and who will support the software after installation. Finally, "Avoid future promises. Focus on what the vendors can do today." P

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Automate Data Collection

Boutique Car Builders

28

34

42

FEATURES

BUSINESS STRATEGIES

28 Clean Fingernails

Thinking about systems integration? Who do you turn to? In this, the first of a series of articles, we examine one alternative, the accounting firm-based integrator.

34 The Boutique Builders Are Coming

CIM/SOFTWARE

42 Automate Data Collection

QUALITY

48 Quality Is a Function of Design at Brown & Sharpe

MANUFACTURING TECHNOLOGIES

52 GE Brings Good Things to NC Programming

MATERIALS

56 Running with the Bulls

Advances in material technology are causing the steel, plastic and aluminum industries to feel fairly bright about their future in the automotive world. Can everyone be a winner?

ASSEMBLY

62 Effective Assembly Automation: A Joint Venture

DESIGN

64 Building Better Products from the Start

68 Is Smaller Better?

MATERIAL HANDLING

70 Keep It Moving—Once You Know Where It's Going

DEPARTMENTS

4	Staff	90	Literature
9	Perspective	94	Classified
10	Production Update	96	Calendar
20	Worth Mentioning	97	Advertisers' Index
24	On The Management Side	97	District Sales Offices
74	Buyers' Guide	98	Back of the Book

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Automate Data Collection

Automating data collection is a fundamental first step to streamlining the flow of information throughout your facility and implementing CIM. Nevertheless, the technique used, be it bar-code or voice technology, is just one piece of the puzzle. The data-collection system must also be planned to fit your company's business goals.

By Paula M. Noaker
Associate Editor

THERE'S NO QUESTION THAT BAR-CODE scanning technology is a cost-effective, flexible, and proven method for tracking inventory, work-in-process (WIP), time and attendance, and more. And it's accurate. According to one report, while keyboarding averages 20 to 30 words per minute with a 40-percent error rate, bar-code scanning technology registers the equivalent of 1,400 to 2,100 words per minute with only one error in 10 million reads. But the technology isn't infallible.

Consider the grocery store. The clerk first runs the Universal Product Code (UPC) label on your can of peaches across a scanner, automatically recording price and product type. He then repeats the procedure for another 20 items until he comes to one that won't register, even though the UPC label is intact. Technically, this is classified as a "non read", not an error.

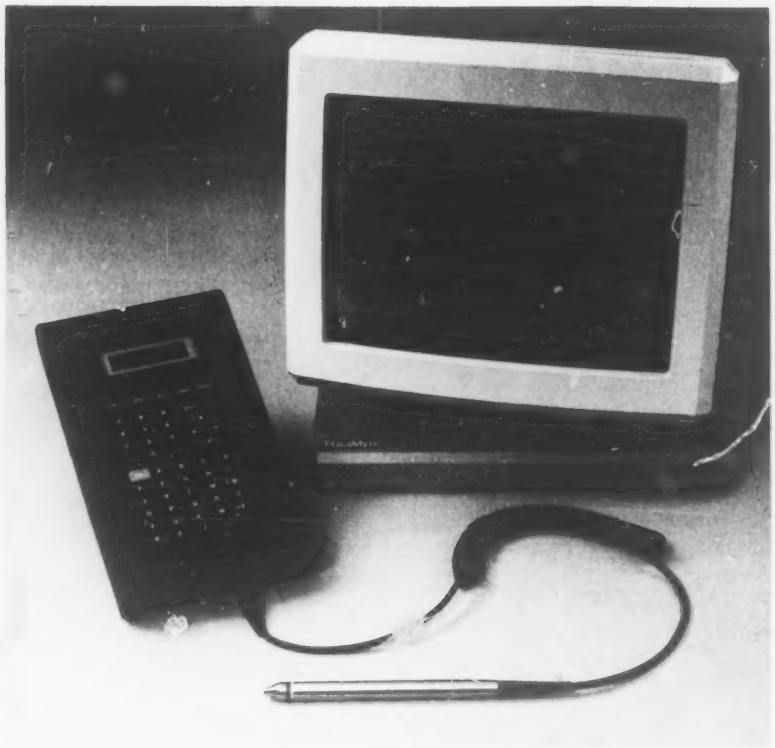
Nevertheless, while a non read barely dents productivity at the check-out counter, a similar occurrence could stop an automated manufacturing line cold. So it's not surprising that alternative automatic identification techniques such as radio-frequency identification (RFID) and voice technology are gaining a small but significant foothold in the factory—often playing a complimentary role to the bar-coding function.

A Little Push from Giants

Unlike DNC, CAD/CAM, or other well-know automation tools, automatic factory data collection (FDC) systems have been slow to catch on with discrete-parts manufacturing companies. By 1991, however, Dataquest (San Jose, CA) predicts a $560 million market for factory FDC, which represents a steady but not explosive 22.5 percent average annual growth since 1982. (Refer to "Industry Trends" charts.)

Factors that significantly affect manufacturing's buying decision include (1) the trend toward networking and integrated manufacturing systems, (2) increased functionality resulting from advances in microprocessor controls and software development, and, last but not least, (3) the need to comply with Department of Defense (DoD) and automotive industry standards.

Since publishing a symbology specification for shipping and parts identification based on the Code 39 bar-code standard, the Automotive Industry Action Group (Southfield, MI) has published five additional standards for primary metals, individual parts, containers, data identifiers, bar-code evaluation guidelines, and a vehicle identification number. According to Automatic Identification Manufacturers, Inc. (AIM; Pittsburgh, PA), as many as 35 to 40 percent of all automotive suppliers are already complying with the standards. Ultimately, up to



Manufacturing's ultimate goal should be perfect parts, perfect processes, and perfect designs, not to mention just-in-time delivery, according to Jerry Houston, Marketing Services Manager, DataMyte (Minnetonka, MN). As a result, companies are beginning to treat manufacturing as a yield-driven process; i.e., they set specific defect rates at each step. To do so, data collection must be accurate and real-time to allow management to make real-time decisions about modifying the process. (Photo courtesy of DataMyte Corp.)

29,000 companies supplying automotive will need to comply.

The Department of Defense, which is in the third revision of its LOGMARS (logistics applications of automated marking and reading symbols) bar-code standard, has targeted this year for full implementation of bar coding in shipping and receiving. The basic thrust is this: If a supplier wishes to do business with the DoD and branches of the military service, his products must carry bar-code symbols in compliance with the military specification. LOGMARS will impact about 50,000 companies.

If your company is one of almost 80,000, where do you begin? By implementing a bar-code-based FDC system? Surprisingly, most experts agree that this isn't a smart move. Implement bar-code technology to comply with standards but also keep your options open to use alternative automatic ID technologies throughout your factory-wide FDC system.

A Place to Start Planning

While automatic FDC is a must for automotive and DoD suppliers, it can also help other discrete-part manufacturers gain control of their facilities information flow. And justification can be fairly straight forward. Bob George, a senior industry analyst at Dataquest explains: "If users can increase capacity utilization with more complete information, then payback is obvious. But if users are looking for a cost savings by reducing employee head count, they will not find a payback in FDC. For FDC to be appealing, a company's goal must be to offset current costs with enhanced decision-making capabilities that allow the project to develop incrementally."

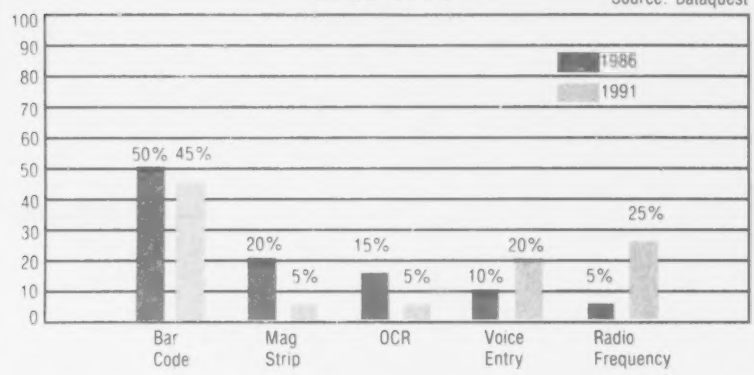
The next logical step is to focus on a need. "Once you're determined to install an automatic identification system, focus on the results desired, not on the available technologies," adds Kevin Sharp, a design engineer for Burr-Brown Quest Division (Tucson, AZ). "Prospective users are easily caught up in making sure they get the latest technology. Subsequently, they spend too little time thinking about the human factors required to make the upgrade a success.

"Pick specific goals, write down the results you want to achieve, and only then start looking for the best technical solution. Goals should be phrased in terms of what data is needed and how the data should be presented." For example:

- Identify all labor expenditures down to the minute.
- Identify all efforts of direct labor that don't contribute directly to the production of items for sale.
- Identify all workstations that produce more defects than the plant average or consistently have idle time.
- Identify all material shortages as manufacturing kits arrive.

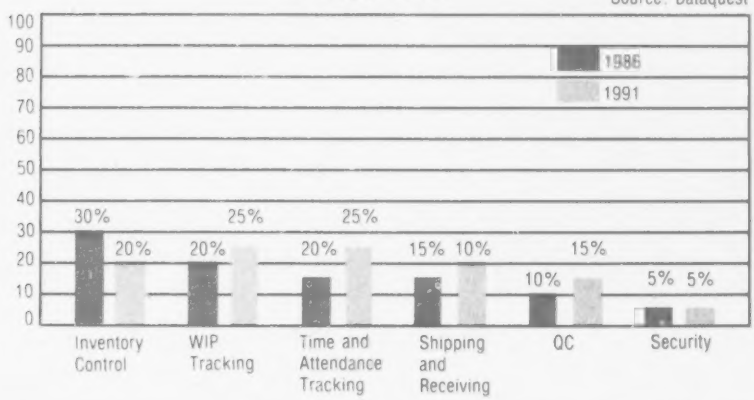
If you can't determine what type of data automates best, Michael T.

U.S. Consumption by Technology 1986-1991



While bar-code scanning technology will continue to hold the lead in the automatic identification market for factory data collection systems, voice technology and radio frequency identification will be used more often in the automation areas where bar codes won't work.

U.S. Consumption by Application 1986-1991



McEachern, supervisor of shop-floor control systems, AT&T Technologies Inc. (Oklahoma City) suggests the following selection criteria:

"A rule of thumb is that any data with a life cycle of 48 hours or less is a prime candidate for automatic data collection. Specifically, target areas involving short-term data (less than four hours) where a person makes a decision quickly and moves the product onward. Then look at areas further out."

After deciding what data needs to be acquired, the next task is to determine how to collect it. It's during this step in the FDC project that you should begin to develop an understanding of the hardware options available.

Sharp stresses, however, that you shouldn't try to design a data-collection system based on an existing paperwork system. By necessity, each piece of paper has every bit of data on it. The FDC system, however, should be designed so the computers remember all the associated information. The operators only need enter new information.

On Automatic ID Systems

A number of technologies comprise the automatic ID family. Each has the same goal of rapid, accurate data collection, but differs in its approach to capturing and processing the data. According to AIM, major options for the shop floor include:

Bar coding. Here, the symbol corresponds to combinations of digits, letters, or other punctuation symbols. Scanners "read" the codes by shining a light at the symbol and monitoring the light reflected back.

Magnetic stripe technology. Information is encoded onto a material using electromagnetic charges. A decoder then translates this information back to a computer. Because large amounts of data can be stored in a single stripe, this technology is widely used for ID badges and time and attendance systems.

Voice data entry. This technology also uses pattern recognition, but instead of images, the computer recognizes words in a pre-programmed vocabulary. The operator speaks into a microphone, the word or phrase is recognized by the machine, and information is sent to the host computer in real time. The computer can then access a file that relates to this information and send additional instructions back to the operator. Because operators train the system to recognize their voices in the environment in which they will be working, on-going background noise usually isn't a problem.

Radio frequency identification. RFID is used in automation and material-handling applications where there is no line of sight between scanner and ID ta or where read/write capability is re ired. A transponder on the object being tracked, which transmits on a specific radio frequency, sends a unique signature or a data stream in response to interrogation by the transmitter/reader. The antenna picks up the signal and the reader decodes and validates the signal for transmission to the host computer. Radio frequency technology

also plays a key role in allowing other automatic ID technologies to transmit information to a computer host via a remote radio link.

Maybe No One Answer Is Right

Although bar coding may be the solution to your problems, realize that it does have some limitations. If you are simply collecting digit information, say a string of alphanumerics, bar-code scanning is still the most cost-effective real-time data-capture method. But it doesn't provide immediate feedback from the computer system. Nor are bar-code tags or labels reusable, as with RFID tags.

So which automatic ID technology works best? That depends on the application. Take fluorescent penetrant inspection of turbine blades for example. The inspector puts the penetrant on a blade, turns out the lights, and looks for surface nicks. Voice input allows him to concentrate on the entire inspection. Otherwise, he would have to stop after each observation, turn on the lights, and jot something down.

Sometimes, two techniques compliment each other, as in the following examples.

- When capturing two different types of information. For instance, an automobile inspector uses voice input to capture characteristics of quality—a nick in the left rear quarter panel or odd color paint job. He also carries an automatic caliper to measure the gap where the door meets the frame. Both observations can be sent to the computer system in real-time via a remote radio link.
- When one technology is cost effective only in harsh or difficult environments. While RFID on the pallet may be required to track a pallet of parts through a machining cell, bar coding may be the most economical method to track individual parts once they leave that cell. In this situation, the parts would be labeled after machining.

Hence, the real productivity impact of FDC systems is felt when these data capture methods are integrated properly into a factory-wide data collection and management system. Management then has a complete information window to the manufacturing facility, not just fragments. Networking or distributed processing is the tie that binds.

Automatic Identification Techniques

	Magnetic Stripes	Bar Codes	RF Tags	Voice Recognition
Scanning Distance		Contact to 36 in.		<36 in.
Industry Standard		Yes		Not Applicable
Handheld Scanners		Yes		Yes (Radio Links)
Tag Making		Easy		Not Applicable
Tagging Reliability		Excellent		Excellent
Data Security		Good To Fair		Good To Fair

Source: Burr-Brown Corp.

To determine which automatic identification technique will work best in a given situation, six things must be evaluated: scanning stations, tag making, environmental limits, data security, reliability of tagging and network compatiblity. Ease of expansion is also important.

Networking and Integration

According to Dataquest, allowing data collection to become a function of a network provides several benefits over a dedicated system (where the data collector is hard-wired to the computer host). Since functionality resides on the network, all the downline terminals are available as data-collection devices for any application on the network. The network can be thought of as the framework for a plant-wide FDC system.

If you've ever lost important data on your office PC, you'll appreciate another network benefit—cost effective redundancy of data storage. Downtime or even loss of data at one processor will not stop the whole system.

While networked data collection systems are gaining favor with advanced FDC system users, dedicated systems are still a large percentage of sales, primarily because they meet the end user's immediate needs and are simple to implement. Unfortunately, this limits your ability to implement cost-effective, incremental FDC automation on a plant-wide basis.

Computer Hardware

Automation Research Corporation (Medfield, MA) reports that computers used for factory data collection

Comments on Data Collection

Setting up connections among devices is straightforward, as is collecting and presenting data. The real challenge is to design your FDC system to collect the "right" data and manage that data so it is available in a useable format when you need it—all without breaking the bank. Here, your best bet is to work with a CIM systems integrator that has direct experience in discrete manufacturing.—*Steven A. Kahan, Software Sales & Marketing, Northern Research & Engineering Corp. (Woburn, MA)*

Make sure your automated data-collection system can grow or change as your company's needs do. For instance, an end user can modify a voice-based data input system in about five minutes utilizing an optional user-friendly software tool.—*Kerry Lamson, General Manager, Westinghouse Voice Systems (Pittsburgh, PA)*

When planning a data collection system, don't limit that system to only the immediate application targeted. The system should be flexible enough to grow into future applications, such as inventory tracking, time and attendance, tool tracking, etc.—*Jeff Laurel, Vice President, Marketing Data Collection Systems Inc. (Minnetonka, MN)*

When I ask people that have installed FDC sytems what they would do differently the next time, most mention this: They'd involve the people who are going to be using the system earlier in the implementation project—not necessarily the cell operators, but at least the foreman.—*Bert R. Willoughby, Automation Consultant, Willoughby & Associates (Pipersville, PA)*

and management range from specialized controllers, office PCs (e.g., IBM PS/2), industrial PCs (e.g., IBM 7552), super-microcomputers, and super-minicomputers. Over the next five years, super-microcomputers will capture the largest share of the market, representing 46.1 percent of systems in use by 1993.

According to experts at Burr-Brown Quest Division, speed, data storage capability, and the type of operator interface will govern the selection of the right computer for your FDC task. In general, computers are required to perform three functions in an identification system: To acquire, to manipulate, and to store data. Each task puts stress on different components of the system; e.g., acquiring and manipulating data tax the computer's processor, while storage of large amounts of data may require a more powerful disk drive than comes with the typical PC.

The computer vendor is the best source of specific data about the processing capability of a particular machine. Sometimes, however, it helps to put your FDC information requirements into a usable format; e.g., I need to be able to store 100,000 transactions or data records of 20 characters each in case my mainframe goes off-line for a day.

Software

Once the data is collected, typical uses include reporting of material, labor, and machinery status; quality control including SPC; and maintenance tracking. While there is a variety of off-the-shelf data-collection software packages, more vendor support for application software development is needed.

The more specific your FDC application is, the harder it will be to buy ready-made software. Nevertheless, while some software customization will be required, this doesn't necessarily mean your software engineers will have to write programs from scratch. Often, off-the-shelf software provides an excellent base from which to tailor your application.

More vendors are also offering software tools to facilitate system configuration; e.g., leading data-collection terminal suppliers now provide terminal configuration software and basic software interfaces for several MRP software packages. In addition, computer companies that sell MRP software—IBM, NCR, and Honeywell, to name a few—are providing data-collection packages that include their own bar-code/badge reader terminals.

The Team Approach

For a brief recap, four types of technologies intertwine to produce a factory data collection system: automatic identification technology; computer hardware; computer software; and networking technologies. The odds are slim that any one person in your company is an expert on all. So, as with other automation projects, it only makes sense to use a team approach—from manufacturing management to the MIS department to the shop-floor foreman—when planning an FDC automation project. P

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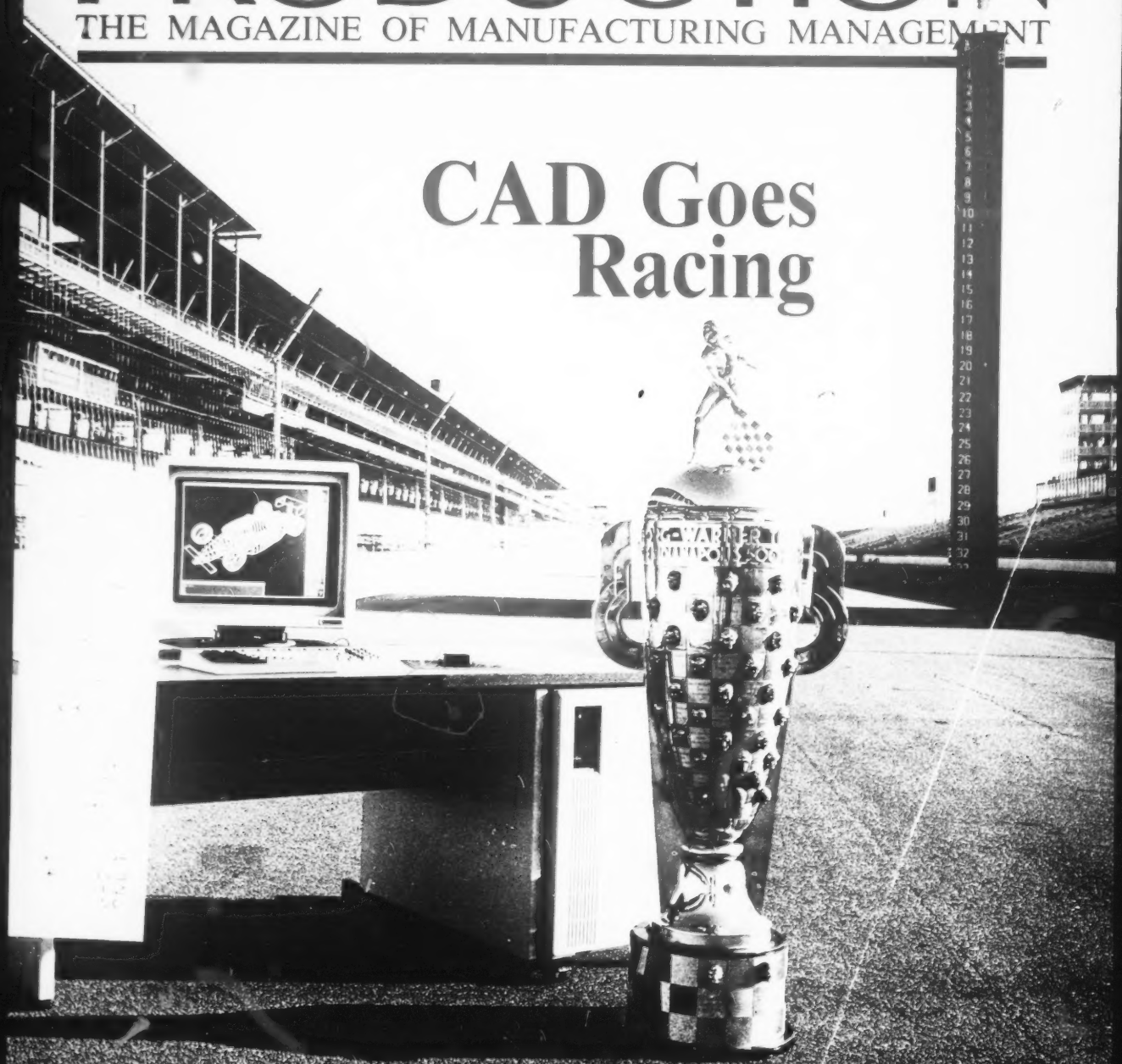
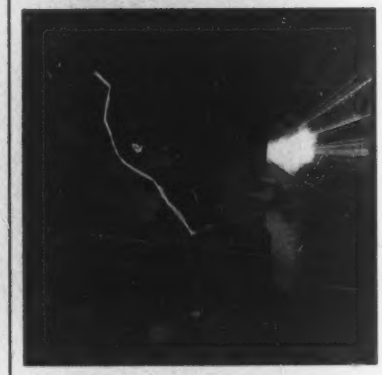


CAD Goes Racing

Adhesives Get a Grip on Automotive

Making Millions of Holes With a Laser

36



46

66

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FEATURES

DESIGN
36 CAD Goes Racing

MANUFACTURING TECHNOLOGIES
46 Laser Drilling's Everyday Technology at GE

52 Machining Cell Tackles Tough Tolerances

BUSINESS STRATEGIES
56 Litton Integrates the Big Picture

63 Operating Intelligence

ASSEMBLY
66 Automakers Turn to Adhesive Solutions

QUALITY
72 The Cost of Quality

MATERIAL HANDLING
78 Taking It Lightly Can Take You Out of the Picture

MATERIALS
82 Of Swizzle Sticks and Refrigerators

CIM/SOFTWARE
86 Workstation Supplier Reaps Benefits of Just-In-Time

DEPARTMENTS

4 Staff
9 Perspective
10 Production Update
28 Worth Mentioning
31 On The Management Side
90 Buyers' Guide
106 Literature
110 Classified
110 Calendar
111 Advertisers' Index
111 District Sales Offices
112 Back of the Book

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Even Japan's Car Builders Have a Tough Time

Some of the statistics that are eagerly awaited in Detroit each month are those that describe the Big Three automakers' monthly sales. During the past several months, the general order has been Ford up, General Motors down, and Chrysler way down.

An interesting piece of information recently came our way, from the always-helpful people at Honda North America. We think it proves enlightening, especially for those persons who think that the tendency for U.S. car builders is to stumble while the Japanese manufacturers march straight ahead.

These are the retail figures for passenger cars sold in Japan:

	February		
	1989	1988	89/88
Honda	26,409	33,273	−21%
Toyota	117,006	135,632	−14%
Nissan	75,012	71,383	+ 5%
Mitsubishi	10,117	13,014	−22%
Mazda	15,110	16,753	−10%
Daihatsu	2,946	2,152	+37%
Fuji	5,278	4,375	+21%
Suzuki	1,485	1,913	−22%
Isuzu	3,269	3,633	−10%
Imports	10,579	8,212	+29%
Total	267,211	290,340	−8%

It doesn't look too indomitable to us.—*GSV*

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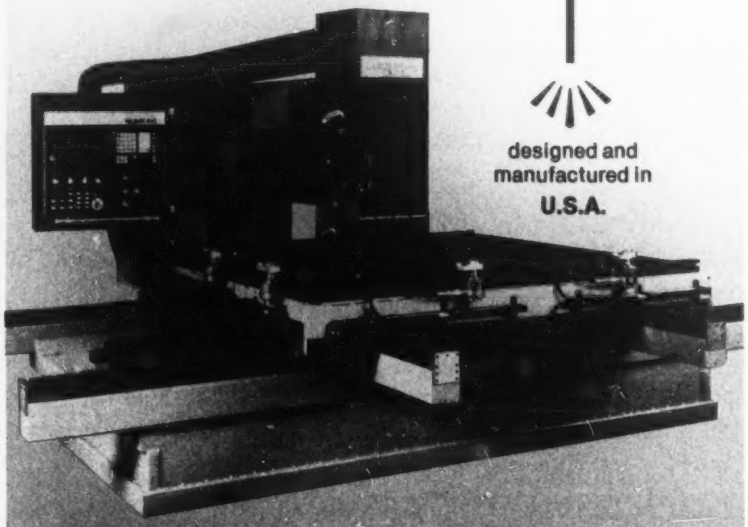

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Change for MTTA

The Machine Tool Trades Association (MTTA) has changed its name to the Machine Tool Technologies Association. President Arthur Mitchell says this change "reflects the overall elements of change in the machine tool industry in recent years."

Stemming from the MTTA's outward mission to the Soviet Union last year, the Association has received an invitation from the Deputy Minister for Machine Building, B. Kurakin, for senior management officials to visit the U.S.S.R. this month. The first mission apparently resulted in a number of agreements and joint ventures between Soviet and British machine tool companies.—*PM*

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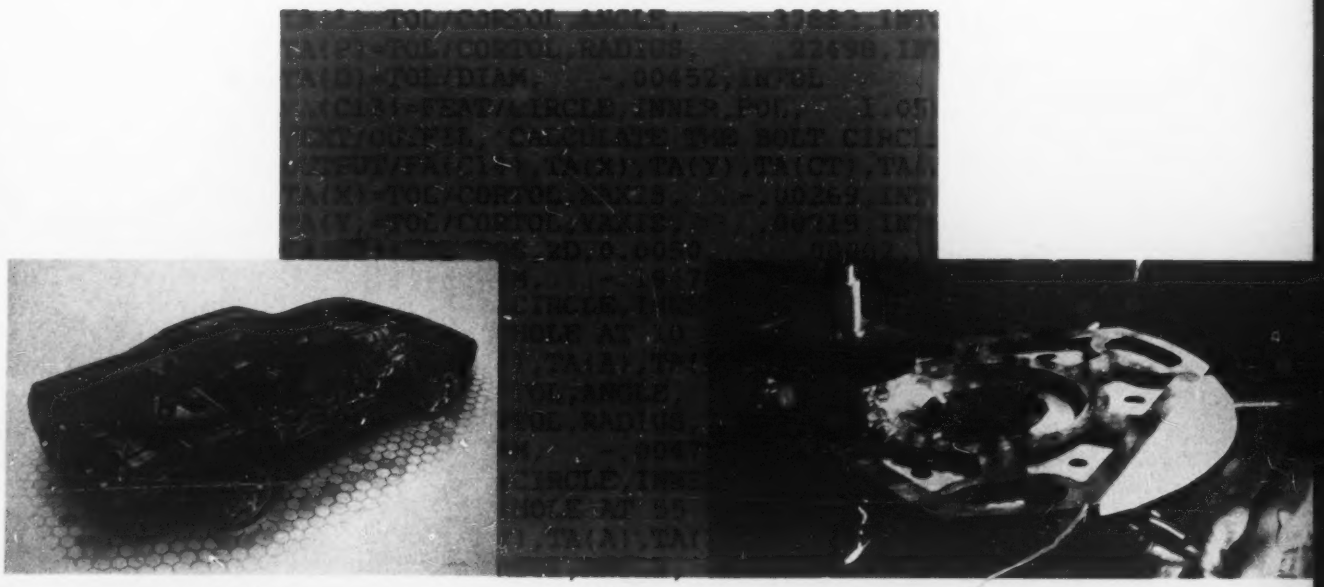

54 36 46

FEATURES

QUALITY

36 The Data Blizzard
This PRODUCTION Round Table takes a look at the impact of data on product quality.

MANUFACTURING TECHNOLOGIES

46 EDM: Are American Manufacturers Missing Something?

ASSEMBLY

54 Sometimes Great Notions Work
The existence of the LT-5 engine that powers the new ZR-1 Corvette is largely the result of effective simultaneous engineering.

BUSINESS STRATEGIES

61 How To Avoid Extinction
Surviving in today's manufacturing arena isn't easy, as evidenced in a recent seminar hosted by Hewlett-Packard. It takes CIM and the people to implement it.

68 Simultaneous Engineering in Action
Lamb Technicon, a production technology manufacturer, knows the difference that simultaneous engineering can make.

CIM/SOFTWARE

73 Planning Software Brings Make-to-Order Alive in Europe

DESIGN

78 A Means to an End
CAD. It's not used just to generate design, but to make better products. Parametric Technology offers some interesting systems that are affordable and learnable.

MATERIALS

83 Here's What Norton Did to Aluminum—and Why

MATERIAL HANDLING

88 Employee Involvement and the Ripple Effect
Deere & Company's Harvester Works has made astonishing moves to cut inventory and the cost of material handling. At the core of its success in this are its people.

DEPARTMENTS

4 Staff
9 Perspective
This Is Teamwork?
26 Worth Mentioning
32 On The Management Side
92 Production Buyers' Guide
106 Literature
112 Calendar/Classified
113 Advertisers' Index
113 District Sales Offices
114 Back of the Book
World Challenge Match

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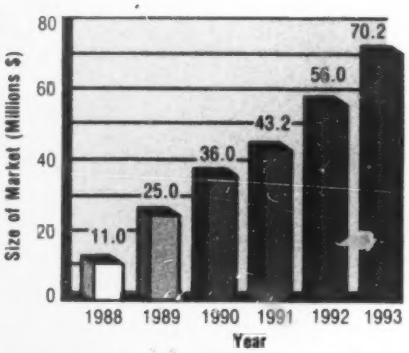
MAP: Stirring or Stalling?

The fate of the market for manufacturing automation protocol (MAP)-based products may hinge on acceptance of and demand for the manufacturing message specification (MMS), according to a recent report by the Yankee Group (Boston, MA) called *Industrial Networks: Standards Update*.

According to Keith Belton, director-Manufacturing Automation Planning Service, the survey indicates that less than one percent of all U.S. industrial sites have installed a MAP network. "Though far more users now require 'support of MAP' from suppliers, the large-scale move to standards is still three years away."

The Yankee Group forecasts the 1989 market for MAP-based offerings and related services to be just $25 million. That figure will grow by more than 30 percent to $36 million during 1990, but, says Belton, it will be a quiet growth.

To get more information on *Industrial Networks: Standards Update* and the Manufacturing Automation Planning Service, contact Corey Green at 617-367-1000.—*BJF*



Closely tied to the development of industrial local-area networks (ILANs) is the central, or "backbone," network, which runs throughout manufacturing facilities. Yankee Group data indicates that today, proprietary network protocols (Ethernet, SNA, and "Other") total 79.3 percent—nearly all of the installed based of plant-wide networks—and it expects that Ethernet will also increase in utilization to more than 30 percent by 1992. Much of this growth will come from large users. Plant-level networks are more likely to be pushed down from corporate sites as they are to be implemented from the bottom up. Ethernet's likely contenders? SNA and TOP, in its final, specified version.

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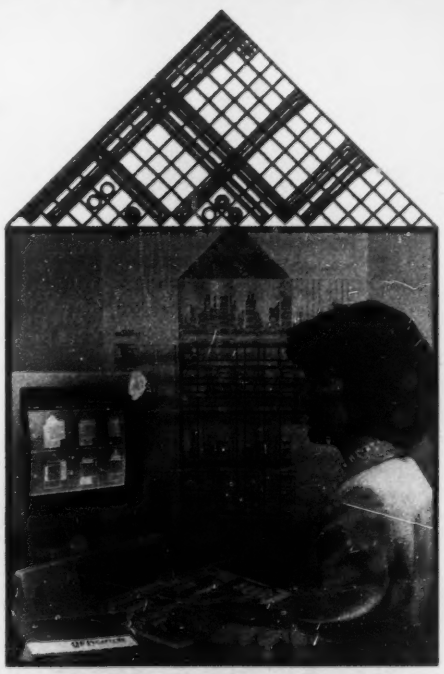

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